# Buying Organic Food: A Multi Level Model of Consumer Behaviour

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Contents





## Theoretical background

1. Economics: Effects of price and income
2. Environmental sciences: Effects of environmental consciousness
3. Health sciences: Effects of health consciousness

## Hypothesis:

1. Price: substitution effect
   - Economics: effect of relative price
   - Psychology: effect of price level
2. Income effect
   - substitution to “higher” quality good
   - size of household
3. Environmental consciousness (EC): no direct measures
   - possession of durable goods like TV, Hi-Fi, dish-washer etc.
   - transportation (travel to work; possession of cars; possession of bicycles)
   - membership in environmental associations
   - education; age
4. health consciousness (HC): no direct measures
   - small children; bad health; age;

| Variable | expected effect on probability of buying organic food |
|---|---|
| relative price | $-$ |
| price level | $-$ |
| income | $+$ |
| household size (income) | $-$ |
| durable goods (EC) | $-$ |
| public transp. (EC) | $+$ |
| automobiles (EC) | $-$ |
| bicycles (EC) | $+$ |
| environm. association (EC) | $+$ |
| education (EC) | $+$ |
| small children (HC) | $+$ |
| bad health (HC) | $+$ |
| age (EC/HC) | convex |
| sex | ? |



**Data:**

- 1998 Income and Consumption Survey (EVE 98)
- income and consumption flows over one month
- 1'500'000 food consumption actions (food/beverages; level 1) in 9000 households (level 2) (average 165 actions/household)
- additional interview on life conditions with 4500 individuals

**Variables**

- Price of good *ik* (*i*: consumption action, *k*: product category): $p_{ik} = z_{ik}/x_{ik}$

  (*x*: amount consumed, *z*: money spent)

- Price estimates:

$$\text{organic: } \hat{p}^b_k = (\textstyle\sum_{i=1}^{n_k} z_{ik} b_{ik})/(\sum_{i=1}^{n_k} x_{ik} b_{ik})$$

$$\text{convent.: } \hat{p}^c_k = [\textstyle\sum_{i=1}^{n_k} z_{ik}(1-b_{ik})]/[\sum_{i=1}^{n_k} x_{ik}(1-b_{ik})]$$

  (*b*: indicator for organic food)

  Possible improvement: $\hat{p}_{ik} = \beta_{0k} + \beta_{1k}\ln(x_{ik})$

- Relative price: $\hat{p}^r_k = \hat{p}^b_k/\hat{p}^c_k$

- Price level: $\hat{p}_k^L = \hat{p}_k^c \cdot \bar{x}_k$

  ($\bar{x}_k = 1/n_k \sum_{i=1}^{n_k} x_{ik}$ standardized units of product $k$)

- Residual price deviation:

$$p_i^d = (p_{ik}(1-b_{ik}) + p_{ik}/\hat{p}_k^r \cdot b_{ik})/\hat{p}_k^c$$

- relative amount: $x_i^r = x_{ik}/\bar{x}_k$

- durable goods: index over dishwasher, freezer, fridge, microwave, TV, Fax, PC, Hi-Fi, mobile phone, video camera, VCR

**Constant elasticity model:** ($j$: household index)

$$\ln\left(\frac{P_{ij}}{1-P_{ij}}\right) = \beta_0 + \beta_1 \ln \hat{p}_k^r + \beta_2 \ln \hat{p}_k^L + \beta_3 \ln p_{ij}^d + \beta_4 \ln x_{ij}^r + \beta_5 \ln(\text{inc}_j) + \boldsymbol{\gamma Z}$$

**Multilevel modeling:**

- Goal: divide within ($\beta^w$) and between ($\beta^b$) estimators

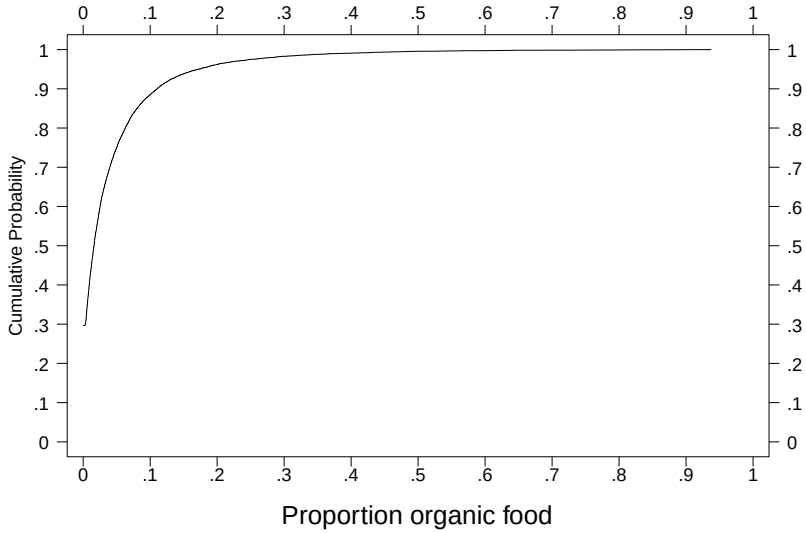
$$y_{ij}^* = \beta_0 + \beta_1^w(\ln \hat{p}_k^r - \overline{\ln \hat{p}_k^r}) + \beta_1^b \overline{\ln \hat{p}_k^r} + \cdots + \varepsilon_{ij}$$

- Estimation:
  - Fixed-effects model ($\beta^w$): household-dummies
  - Between-effects m. ($\beta^b$): reg. with aggregates
  - Random-effects m. ($\beta^w$ and $\beta^b$): $\beta_{0j} = \beta_0 + u_j$



  - Std. logistic regression (clustered Huber/White sandwich estimator):
    - consistent (in large samples: same point estimates as in fixed-effects/between-effects models) but less efficient
    - Problem: unbalanced Panels $\Rightarrow$ households with many consumption actions ($n_j$) have more influence on point estimates
    - Possible solution: apply (p)weights $1/n_j$
      - between estimator: consistent
      - within estimator: unclear
      - loss of efficiency

**Results:**




Mean proportion of organic food: 4.2%

| | M1 | | M2 | | M3 | |
|---|---|---|---|---|---|---|
| w.rel.price | -0.337 | -16.52 | -0.590 | -24.59 | -0.573 | -24.11 |
| w.level | | | -0.622 | -31.22 | -0.638 | -31.95 |
| w.rel.dev | | | | | -0.228 | -18.78 |
| w.rel.amount | | | | | -0.170 | -14.99 |
| constant | -3.104 | -149.52 | -3.135 | -148.20 | -3.141 | -147.34 |

dependent: organic food; estimation: Logit (sandwich/cluster), unweighted, $n = 1426881$

| | M4 | | M5 | | M6 | |
|---|---|---|---|---|---|---|
| w.rel.price | -0.588 | -24.47 | | | -0.588 | -24.47 |
| b.rel.price | -0.567 | -1.00 | | | -0.580 | -1.03 |
| w.level | -0.692 | -32.08 | | | -0.692 | -32.09 |
| b.level | -6.063 | -17.47 | | | -6.060 | -17.59 |
| w.rel.dev | -0.232 | -18.85 | | | -0.232 | -18.87 |
| b.rel.dev | 2.911 | 14.01 | | | 2.901 | 12.94 |
| w.rel.amount | -0.180 | -15.19 | | | -0.180 | -15.20 |
| b.rel.amount | -0.995 | -8.88 | | | -0.934 | -7.45 |
| ln(income) | | | 0.192 | 4.34 | -0.004 | -0.08 |
| hh_size | | | -0.162 | -9.49 | -0.018 | -0.98 |
| constant | 4.631 | 9.07 | -4.380 | -11.43 | 4.728 | 7.03 |

dependent: organic food; estimation: Logit (sandwich/cluster), unweighted, $n = 1426881$



| | M7 | | M8 | | M9 | |
|---|---|---|---|---|---|---|
| z.rel.price | -0.592 | -24.50 | -0.573 | -13.15 | -0.559 | -11.02 |
| m.rel.price | -0.354 | -0.63 | 0.655 | 0.71 | 1.418 | 1.27 |
| z.level | -0.698 | -32.23 | -0.691 | -17.35 | -0.715 | -14.50 |
| m.level | -5.130 | -15.66 | -5.353 | -9.69 | -4.599 | -6.93 |
| z.rel.dev | -0.233 | -18.84 | -0.251 | -10.60 | -0.251 | -9.23 |
| m.rel.dev | 2.829 | 13.00 | 2.496 | 7.06 | 2.521 | 5.85 |
| z.rel.amount | -0.183 | -15.35 | -0.207 | -8.87 | -0.209 | -7.83 |
| m.rel.amount | -0.524 | -4.32 | -0.758 | -3.77 | -0.548 | -2.23 |
| ln(income) | 0.103 | 2.24 | 0.060 | 0.72 | -0.004 | -0.05 |
| hh_size | -0.137 | -6.13 | -0.145 | -3.41 | -0.171 | -3.73 |
| goods | -0.104 | -9.10 | -0.076 | -3.94 | -0.079 | -3.43 |
| cars | -0.242 | -7.07 | -0.265 | -4.59 | -0.262 | -3.69 |
| bicycles | 0.116 | 8.69 | 0.116 | 4.53 | 0.127 | 4.58 |
| age | 0.051 | 5.46 | 0.058 | 3.42 | 0.083 | 3.36 |
| $age^2/10$ | -0.005 | -5.29 | -0.005 | -3.20 | -0.008 | -2.86 |
| env.ass | | | 0.996 | 3.88 | 1.066 | 3.59 |
| pub.transp. | | | | | 0.137 | 1.57 |
| education | 0.054 | 7.49 | 0.057 | 4.12 | 0.051 | 3.58 |
| child $< 4$ | 0.422 | 6.58 | 0.557 | 4.40 | 0.606 | 4.39 |
| bad health | | | -0.085 | -0.85 | -0.300 | -2.46 |
| women | -0.039 | -0.90 | -0.062 | -0.81 | 0.004 | 0.05 |
| constant | 1.674 | 2.61 | 1.654 | 1.42 | 0.642 | 0.50 |
| cases | 1418803 | | 366540 | | 267051 | |

dependent: organic food; estimation: Logit (sandwich/cluster), unweighted

| | M1 | | M2 | | M3 | |
|---|---|---|---|---|---|---|
| w.rel.price | -0.340 | -8.30 | -0.591 | -12.10 | -0.578 | -11.89 |
| w.level | | | -0.601 | -14.97 | -0.622 | -15.57 |
| w.rel.dev | | | | | -0.253 | -10.67 |
| w.rel.amount | | | | | -0.210 | -9.07 |
| constant | -3.093 | -139.76 | -3.123 | -136.53 | -3.131 | -135.85 |

dependent: organic food; estimation: Logit (sandwich/cluster), weighted, $n = 1426881$

| | M4 | | M5 | | M6 | |
|---|---|---|---|---|---|---|
| w.rel.price | -0.594 | -11.90 | | | -0.594 | -11.89 |
| b.rel.price | -0.503 | -0.83 | | | -0.496 | -0.82 |
| w.level | -0.675 | -15.44 | | | -0.675 | -15.44 |
| b.level | -5.022 | -13.81 | | | -5.019 | -13.84 |
| w.rel.dev | -0.263 | -10.93 | | | -0.263 | -10.93 |
| b.rel.dev | 2.595 | 12.21 | | | 2.587 | 11.47 |
| w.rel.amount | -0.223 | -9.34 | | | -0.223 | -9.34 |
| b.rel.amount | -0.905 | -7.26 | | | -0.866 | -6.15 |
| ln(income) | | | 0.156 | 3.28 | 0.000 | 0.01 |
| hh_size | | | -0.155 | -8.22 | -0.013 | -0.64 |
| constant | 3.295 | 6.23 | -4.099 | -9.96 | 3.329 | 4.72 |

dependent: organic food; estimation: Logit (sandwich/cluster), weighted, $n = 1426881$



| | M7 | | M8 | | M9 | |
|---|---|---|---|---|---|---|
| z.rel.price | -0.601 | -12.03 | -0.678 | -8.02 | -0.692 | -6.94 |
| m.rel.price | -0.318 | -0.53 | -0.171 | -0.17 | 0.112 | 0.10 |
| z.level | -0.685 | -15.61 | -0.835 | -10.38 | -0.838 | -8.13 |
| m.level | -4.299 | -12.19 | -4.554 | -7.69 | -3.975 | -6.21 |
| z.rel.dev | -0.264 | -10.91 | -0.288 | -6.35 | -0.314 | -5.87 |
| m.rel.dev | 2.515 | 10.98 | 2.079 | 5.69 | 1.819 | 4.18 |
| z.rel.amount | -0.224 | -9.38 | -0.227 | -5.59 | -0.238 | -4.97 |
| m.rel.amount | -0.503 | -3.56 | -0.746 | -2.89 | -0.523 | -1.63 |
| ln(income) | 0.103 | 1.91 | 0.057 | 0.65 | 0.006 | 0.06 |
| hh_size | -0.120 | -4.71 | -0.168 | -3.31 | -0.177 | -3.27 |
| goods | -0.109 | -8.32 | -0.083 | -3.67 | -0.096 | -3.62 |
| cars | -0.256 | -6.74 | -0.275 | -3.98 | -0.251 | -2.92 |
| bicycles | 0.114 | 7.17 | 0.118 | 3.58 | 0.117 | 3.19 |
| age | 0.051 | 4.54 | 0.059 | 2.83 | 0.070 | 2.63 |
| $age^2/10$ | -0.005 | -4.39 | -0.006 | -2.74 | -0.006 | -2.25 |
| env.ass | | | 0.842 | 3.55 | 0.766 | 2.80 |
| pub.transp. | | | | | 0.158 | 1.58 |
| education | 0.052 | 6.45 | 0.037 | 2.31 | 0.032 | 1.82 |
| child $< 4$ | 0.420 | 5.81 | 0.588 | 3.75 | 0.617 | 3.57 |
| bad health | | | -0.048 | -0.44 | -0.180 | -1.24 |
| women | -0.112 | -2.35 | -0.169 | -1.96 | -0.096 | -0.98 |
| constant | 0.669 | 0.94 | 1.211 | 1.04 | 0.692 | 0.54 |
| cases | 1418803 | | 366540 | | 267051 | |

dependent: organic food; estimation: Logit (sandwich/cluster), weighted

## A look ahead

- Formalized theory (economic part)
- Improved price estimation
- Refined model
- Theory of life cycles; family composition
- Estimation: advanced models (random-coefficient)?
  sampling?
- EVE 2000?